Janel Wu

Chris Surro

Econ 187

13 Jun 2024

Pandemic Schooling Mode and Students' Test Score for Difference Races

1 Introduction

ABC News has reported that the COVID-19 pandemic has exacerbated racial disparities in education. The pandemic led to the tragic loss of over a million lives and left 140,000 children without parents. Alarmingly, 65% of these children are from communities of color. This significant loss has not only inflicted emotional trauma but also disrupted the economic stability that is crucial for a child's education. As a result, many students are encountering severe challenges as they approach critical educational milestones, such as graduation.

One of the most striking impacts of the pandemic on education has been the decline in test scores. One of the reasons for this decline is the abrupt shift from traditional in-person learning to virtual studies. The change in schooling mode has posed unique challenges and highlighted inequities within the educational system. As someone deeply concerned about education and inequality, I have chosen to focus my research on the impact of pandemic-induced changes in schooling mode on the test scores of students from various racial backgrounds across U.S. states. I have also experienced and struggled with switching from in-person to virtual learning. This research topic is valuable because it aims to provide insights that can inform education policymakers. By understanding how the pandemic has differentially affected students, especially those from marginalized communities, interventions can be designed to support the most affected students and address educational inequalities. The ultimate goal is to foster an

educational environment where all students, regardless of race, have equal opportunities to succeed.

2 Literature review

Many research projects analyze racial disparities regarding COVID-19 in education and I found two articles that have close answers to the question I will be analyzing. The first research is *Pandemic Schooling Mode and Student Test Scores: Evidence from US School Districts*, which estimates the impact of district-level schooling mode in the 2020–2021 school year on students' pass rates on standardized tests in grades 3–8 across 11 states. The team found an estimating equation that evaluates the students' pass rates based on the amount of virtual and in-person learning they had. The results showed that pass rates declined from 2019 to 2021: an average of 12.8 percentage points in math and 6.8 in English language arts (ELA). They also found that the value of in-person learning was larger for districts with larger populations of Black, Hispanic, or eligible for free and reduced-price lunch students. Overall, in-person learning is better than remote learning in ELA and math. Thus, ELA and math scores are lower for districts with more marginalized students since these students are more affected by changing to online learning. Another research called *Racial Differences in Parent Response to COVID Schooling Policies* examines whether school COVID-19 policies influenced enrollment differently by student age and race/ethnicity. The paper has two significant findings: non-White populations were more likely to disenroll from districts offering in-person schooling in the fall of 2020, and white enrollments declined more than Black, Hispanic, and Asian enrollments in districts that started the 2020–2021 school year virtually, but in districts that started in-person the reverse was true. Students of color are more likely to drop from in-person schooling, while white populations are more likely to decline from virtual schooling. The two papers together have already given a close

answer to my research question that Black and Hispanic students are more affected by the disruptions in schooling mode compared to White students. The research topic can further analyze the extent of this racial difference in education.

3 Ideal Research Design

If there were no limitations to the data and information, useful data would include the test scores and the distributions of schooling modes across different states in the U.S. before and after COVID-19, ideally from 2017 to 2022, so that there would be enough data to conclude the changes in test scores. The subjects of the test scores are likely to be ELA, math, and science because most students are required to take these subjects to ensure a large enough population for research. Students can be chosen from k3-k12 because I could analyze the different extent of effects on students of different ages. I also need the racial information of these students. Then, after collecting the data, I first need to do some preliminary research by looking at the different test scores across states and races to ensure there are changes in test scores. Next, I can take the average of the differences in test scores across different states and races and visualize the results. Finally, I would take a regression analysis of the data given. The regression-dependent variable is the pass rates of the subjects chosen, and the independent variables include the races, in-person percentage, virtual percentage, hybrid percentage, and students' ages. This regression should also include interaction terms between race, percentages of schooling modes, and races to examine the extent of racial differences of schooling modes in pass rates. Another interaction term is between ages, percentages of schooling modes, and races to examine the extent of age differences of schooling modes in pass rates. Together, the results from the graph and regression analysis could be enough to answer the research question.

4 Findings

	Districts	Avg Years	% In-Person	% Hybrid	% Virtual	% Black & Hispanic
CO	136.0	4.713235	28.878149	43.781115	27.340737	37.765522
CT	160.0	4.950000	47.408286	36.257164	9.121080	35.138254
MA	284.0	4.000000	27.411022	54.359274	18.229707	26.936076
MN	340.0	4.891176	16.170310	69.080517	14.749173	NaN
MS	134.0	4.895522	66.707769	18.405504	14.886726	51.515966
OH	606.0	5.000000	50.031506	32.089664	17.139591	19.033916
RI	37.0	2.918919	44.468268	41.757298	8.211751	31.508792
VA	132.0	5.000000	9.660680	51.772454	38.566866	37.403517
WI	396.0	4.989899	51.460636	22.059117	18.379224	19.885102
WV	55.0	5.000000	37.559544	41.433551	17.389498	6.131076
WY	48.0	3.000000	86.516049	6.229361	0.734952	14.702178

Table 1—Summary Statistics by State and Overall

Table 1 presents the preliminary summary statistics. This table includes the average years of assessment data, the average percent of the school year that districts offered each schooling mode, and district demographic characteristics. By state, in-person schooling rates are highest in Wyoming (86.5 percent) followed by Mississippi (66.7 percent), and lowest in Minnesota (16.2 percent) and Virginia (9.7 percent). On the other hand, the highest share of time spent in fully virtual studying is in Virginia and Colorado (38.6 percent and 27.3 percent, respectively). The table also presents that states have various demographic characteristics, particularly different shares of Black and Hispanic students.

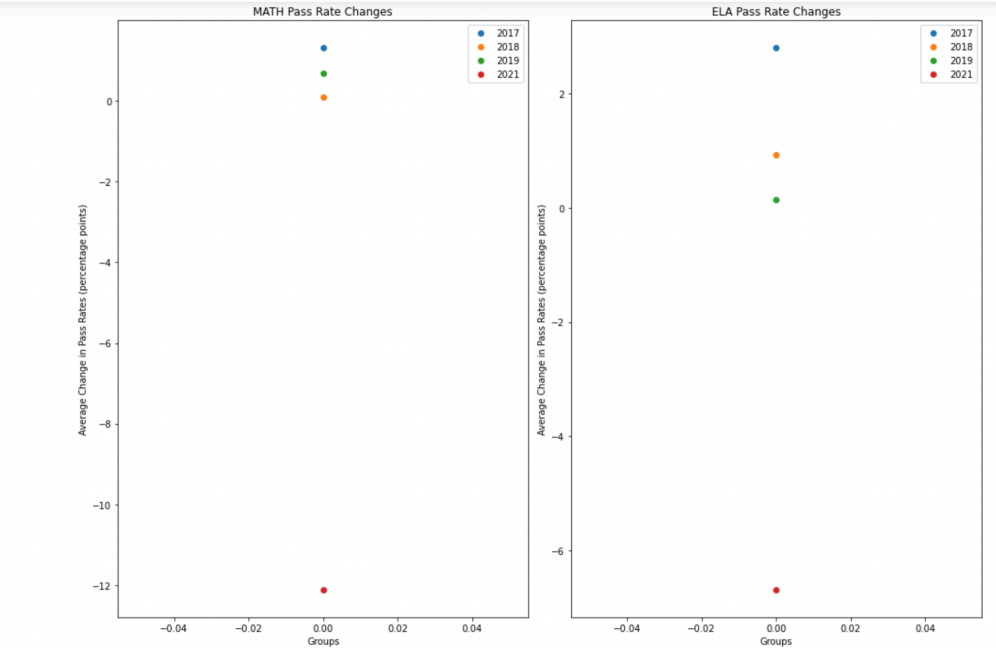

Figure 1. Average Overall Change in Pass Rates on State Standardized Assessments in Spring 2021 versus Spring 2016–2019

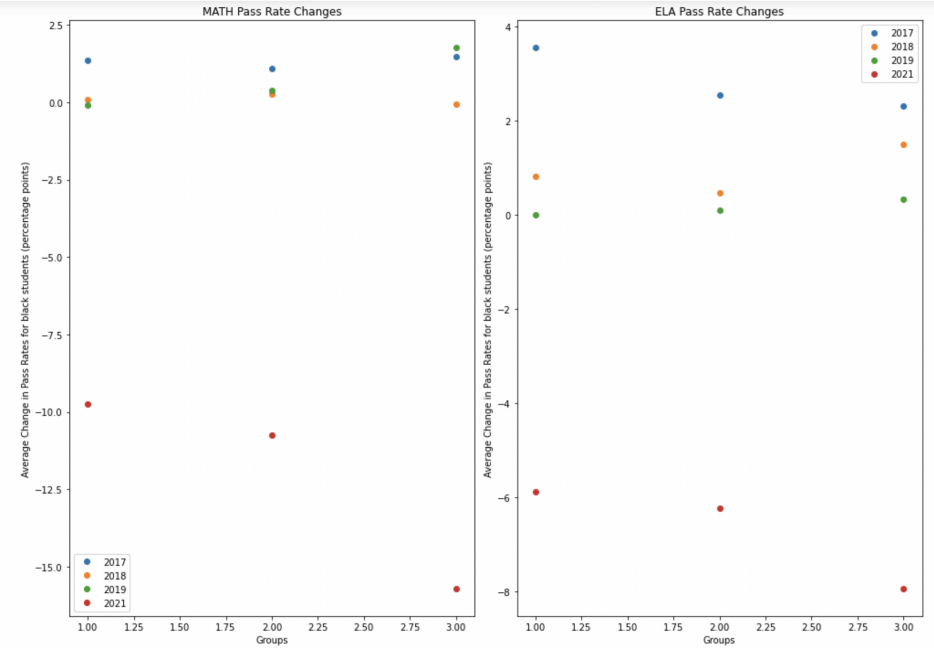

Figure 2. Average Change in Pass Rates on State Standardized Assessments in Spring 2021 versus Spring 2016–2019 for Black Students

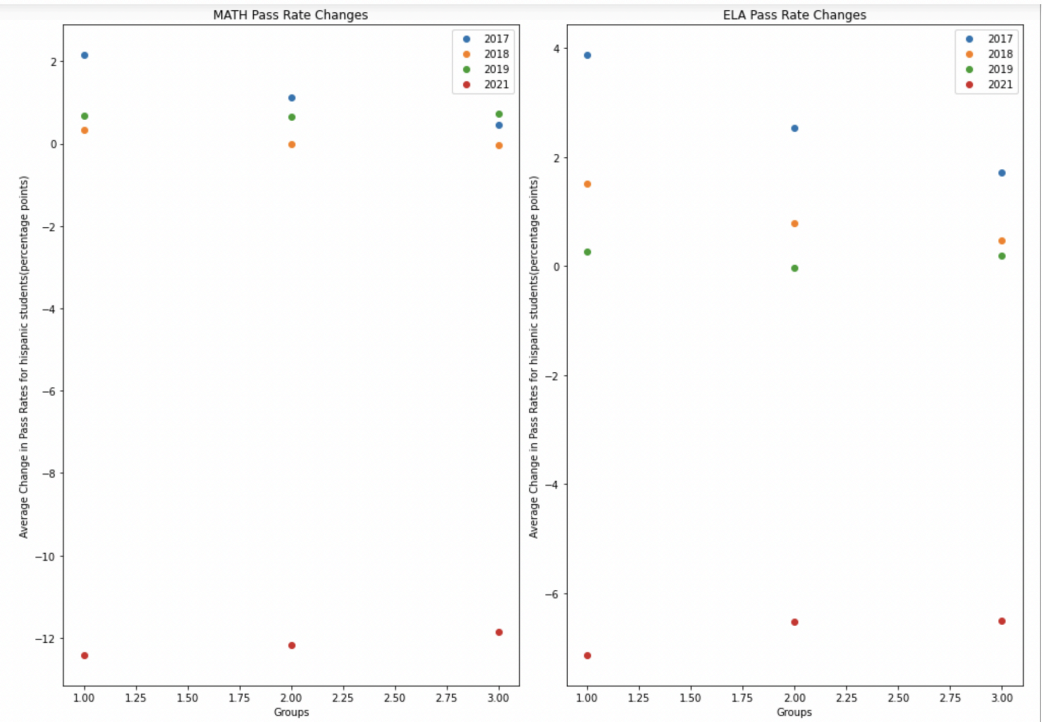

Figure 3. Average Change in Pass Rates on State Standardized Assessments in Spring 2021 versus Spring 2016–2019 for Hispanic Students

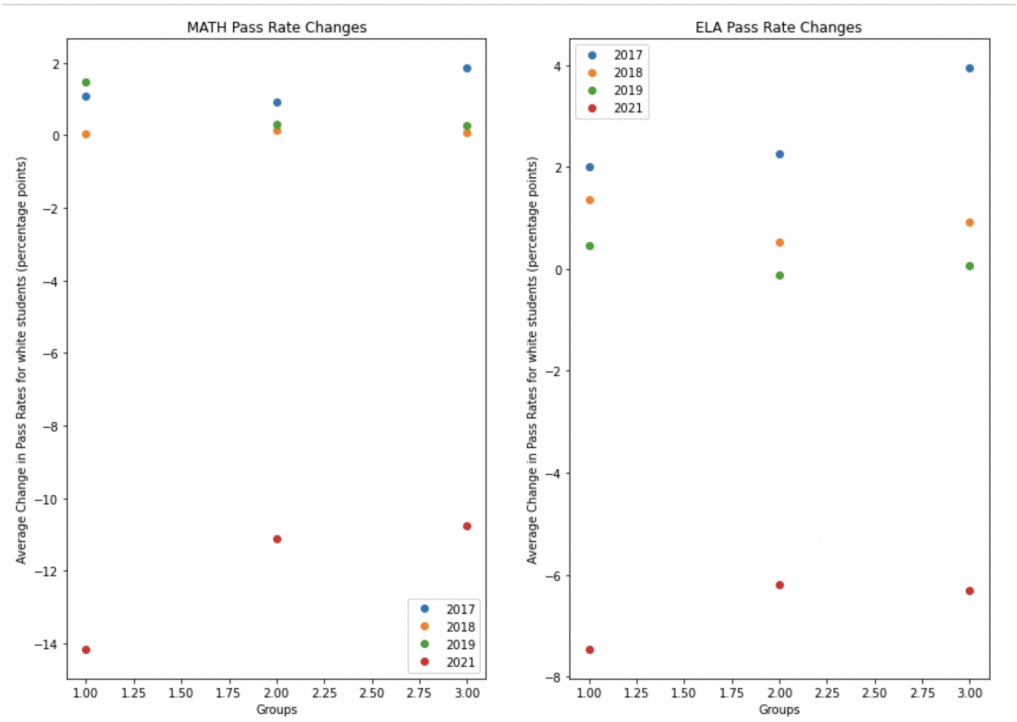

Figure 4. Average Change in Pass Rates on State Standardized Assessments in Spring 2021 versus Spring 2016–2019 for White Students

Figures 1-4 are the average change in pass rates on pass rates for math and ELA before and after COVID-19. The overall math pass rates for all students have declined by 12.12%, and the ELA pass rates have declined by 6.69%. Thus, math has been impacted more than ELA by the pandemic. Figure 1 also validates this result and shows that the red dot representing Spring 2021 is an outlier compared to the other three years. Figure 2 shows a decreasing trend while Figures 3, and 4 show an increasing trend for both subjects. The three columns represent the three quantiles of the share of students by race. The left-most quantile has the smallest share of students by a certain race while the right-most quantile has the largest share of students by a certain race. Therefore, Figure 2 shows that the increasing share of Black students decreases both math and ELA pass rates. Conversely, more Hispanic and White students do not decrease the math and ELA pass rates. As a result, according to graph visualization, Black students are more likely to be affected by the change in schooling mode compared to White and Hispanic students.

Model Schooling Mode and Changes in Pass Rate_math Summary:

WLS Regression Results

Dep. Variable:	Q("pass")	R-squared:	0.188
Model:	WLS	Adj. R-squared:	0.187
Method:	Least Squares	F-statistic:	283.3
Date:	Sun, 09 Jun 2024	Prob (F-statistic):	0.00
Time:	00:41:28	Log-Likelihood:	-1506.4
No. Observations:	11041	AIC:	3033.
Df Residuals:	11031	BIC:	3106.
Df Model:	9		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-0.1246	0.027	-4.612	0.000	-0.178	-0.072
inperson_2021	0.0765	0.012	6.139	0.000	0.052	0.101
hybrid_2021	0.0377	0.014	2.791	0.005	0.011	0.064
black_2021_inperson	0.1649	0.057	2.897	0.004	0.053	0.276
black_2021_hybrid	-0.2905	0.054	-5.374	0.000	-0.396	-0.185
hisp_2021_inperson	-0.8030	0.058	-13.851	0.000	-0.917	-0.689
hisp_2021_hybrid	-0.3251	0.064	-5.043	0.000	-0.452	-0.199
unemployment	-0.0090	0.001	-6.213	0.000	-0.012	-0.006
participation	0.0072	0.000	27.802	0.000	0.007	0.008
participate_denom	1.472e-06	1.24e-07	11.902	0.000	1.23e-06	1.71e-06

Omnibus:	4049.855	Durbin-Watson:	1.186
Prob(Omnibus):	0.000	Jarque-Bera (JB):	84625.687
Skew:	-1.250	Prob(JB):	0.00
Kurtosis:	16.330	Cond. No.	7.00e+05

Table 2—Schooling Mode and Changes in Math Pass Rates

Model Schooling Mode and Changes in Pass Rate_ela Summary:
WLS Regression Results

Dep. Variable:	Q("pass")	R-squared:	0.118
Model:	WLS	Adj. R-squared:	0.117
Method:	Least Squares	F-statistic:	163.9
Date:	Sun, 09 Jun 2024	Prob (F-statistic):	1.23e-292
Time:	00:41:28	Log-Likelihood:	-194.63
No. Observations:	11064	AIC:	409.3
Df Residuals:	11054	BIC:	482.4
Df Model:	9		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.1505	0.024	6.259	0.000	0.103	0.198
inperson_2021	0.0733	0.011	6.649	0.000	0.052	0.095
hybrid_2021	0.1057	0.012	8.825	0.000	0.082	0.129
black_2021_inperson	0.1299	0.050	2.575	0.010	0.031	0.229
black_2021_hybrid	-0.1635	0.048	-3.400	0.001	-0.258	-0.069
hisp_2021_inperson	-0.7546	0.051	-14.720	0.000	-0.855	-0.654
hisp_2021_hybrid	-0.3790	0.057	-6.665	0.000	-0.490	-0.268
unemployment	-0.0047	0.001	-3.639	0.000	-0.007	-0.002
participation	0.0044	0.000	19.190	0.000	0.004	0.005
participate_denom	2.073e-06	1.1e-07	18.809	0.000	1.86e-06	2.29e-06

Omnibus:	4383.810	Durbin-Watson:	1.222
Prob(Omnibus):	0.000	Jarque-Bera (JB):	135055.430
Skew:	-1.280	Prob(JB):	0.00
Kurtosis:	19.924	Cond. No.	6.99e+05

Table 3—Schooling Mode and Changes in ELA Pass Rates

I constructed a weighted least squares regression, different from the regression model in *Pandemic Schooling Mode and Student Test Scores: Evidence from US School Districts*. WLS regression can deal with the violation of the assumption of constant variance. Tables 2 and 3 are the results of this regression which includes pass rates as a dependent variable, interactive terms percentage of in-person in the year 2021, percentage of virtual in the year 2021, percentage of in-person for Black students in year 2021, percentage of virtual for Hispanic students with year 2021, other independent variables unemployment rate, and participation rates. The coefficient on the interaction term of the share of Black students with the share of in-person schooling in the year 2021 is positive for math, and it is significant since the p-value is less than 0.05. Comparing this coefficient to the interaction term of the share of in-person learning in the year 2021, the impact of in-person learning is more than three times as large for a district with 100 percent

Black students versus 0 percent Black students. On the other hand, ELA, a district with 100 percent Black students is one time the impact of in-person learning for 0 percent Black students. In other words, this effect is more significant in math compared to ELA, which also supports the two times higher decline in pass rate for math in the preliminary analysis. Furthermore, the regression tables do not show similar results for Hispanic students, supporting the increasing trend in the graph visualization above. This regression analysis is not perfect as the R-square is only 0.118, which means only 11.8% of the variance of the dependent variable can be explained by the independent variables.

5 Reflection

The question is difficult to answer because of the endogeneity in schooling mode. In other words, districts with less in-person learning were more affected by other factors of the pandemic. Therefore, the decline in test scores cannot be completely concluded as a result of the change in schooling mode. For instance, the lockdown of after-school activities might also impact students' learning, resulting in lower pass rates of math and ELA. As a result, the biggest challenge to answer this question is to separate schooling changes from other changes of the pandemic because there exists colinearity between these restrictions. Furthermore, test scores are only one of the measurements of the quality of students' learning. For policymakers to create a more equal educational environment for all students, more research is needed, in particular, to analyze the problem from other measurements, such as students' mental health. If I had more time to work on this question, I would analyze the impact of the pandemic on students with reduced lunch, English as a second language students, and students of different ages. The first two cases of students potentially would experience more challenges during virtual learning than other students. It would also be reasonable to suspect a larger impact of virtual learning on younger

age students since younger students are still regulating their behaviors and they are also harder to focus attention. I think it would be possible to have a definitive answer to my question, which requires more analysis of other measurements of students' learning as I mentioned earlier, and more recent data information to examine the long-term effects of the pandemic on education.